

CLAIMS

WHAT IS CLAIMED IS:

1 1. A stabilized dual zeolite low coke forming single particle catalyst, bonded with
2 silica alumina binder, suitable for cracking heavy residual hydrocarbon feeds and having
3 enhanced hydrothermal stability, said catalyst comprising:

- 4 (a) stabilized high silica zeolite in the range of 1 wt% to 50 wt%;
5 (b) low silica molecular sieve in the range of 1 wt% to 40 wt%;
6 (c) silica in the range of 1 wt% to 15 wt%;
7 (d) alumina in the range of 5 wt% to 30 wt%; and
8 (e) clay in the range of 10 wt% to 50wt%;

1 2. A catalyst according to claim 1 wherein the stabilized high silica zeolite
2 consisting of:

- 3 (a) a phosphate source in the range of 1 wt% to 40 wt%;
4 (b) high silica zeolite in the range of 5 wt% to 99 wt%; and
5 (c) clay in the range of 0 wt% to 50 wt%.

1 3. A catalyst according to claims 1 and 2 wherein the clay is selected from the group
2 consisting of kaolin and halloysite.

1 4. A catalyst according to claim 1 wherein the high silica zeolite is selected from the
2 group consisting of ZSM-5, ZSM-11, ZSM-12, ZSM-23, ZSM-35, ZSM-38, ZSM-48, ZSM-57,
3 Zeolite beta, mordenite and preferably ZSM-5.

1 5. A catalyst according to claim 1 wherein the low silica molecular sieve is selected
2 from the group consisting of faujasite, mordenite, beta, MCM mesoporous zeolite and L.

1 6. A catalyst according to claim 1 wherein the low silica molecular sieve is
2 exchanged with NH₃.

1 7. A catalyst according to claim 1 wherein the low silica molecular sieve is
2 exchanged with rare earth cations selected from the group consisting of lanthanum, cerium,
3 praseodymium, neodymium, samarium and gadolinium.

1 8. A catalyst according to claim 1 wherein the low silica molecular sieve having rare
2 earth metal oxides in the range of 0.1 to 10 wt%.

1 9. A catalyst according to claim 1 wherein the phosphate source is selected from the
2 group consisting of phosphoric acid, ammonium di hydrogen phosphate, ammonium mono
3 hydrogen phosphate, tri-ammonium phosphate, ammonium hypophosphate, ammonium ortho
4 phosphate, ammonium di hydrogen ortho-phosphate, ammonium mono hydrogen ortho-
5 phosphate, ammonium hypo phosphite, ammonium di hydrogen ortho-phosphite or a mixture
6 thereof.

1 10. A catalyst according to claim 1 wherein the alumina is a pseudoboehmite having a
2 crystal size ranging from about 3 nm to 30 nm.

1 11. A catalyst according to claim 1 wherein the silica is in colloidal form of particles
2 having a mean diameter ranging from about 4 nm to 30 nm.

1 12. A catalyst according to claim 1 wherein the stabilized high silica zeolite has silica
2 to alumina ratio from 10 to 300.

1 13. A catalyst according to claim 1 wherein the silica alumina binder is a reaction
2 product of acidified colloidal silica and acidified pseudoboehmite alumina.

1 14. A catalyst according to claim 1 wherein the organic acid used for acidifying
2 colloidal silica is selected from the group consisting of nitric acid, hydrochloric acid, formic acid
3 and acetic acid.

1 15. A catalyst according to claim 1 wherein the organic acid used for acidifying
2 pseudoboehmite alumina is selected from the group consisting of acetic acid, formic acid, nitric
3 acid and hydrochloric acid or a mixture thereof.

1 16. A catalyst according to claim 1 wherein said catalyst produces gasoline having
2 Research Octane Number (RON) 92-93.

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21. A process according to claim 20 stabilization of high silica zeolite can be optionally performed in the following steps:

- (a) preparing phosphate-clay slurry using a phosphate source and a clay with demineralised water;
- (b) adding high silica zeolite to the slurry;
- (c) drying the product at a temperature in the range of 60-120°C in an oven; and
- (d) pulverizing the product followed by calcination at about 400-600°C to obtain stabilized high silica zeolite;

22. A process according to claim 20 wherein the stabilized high silica zeolite has silica to alumina ratio from 10 to 300.

23. A process according to claim 20 wherein the high silica zeolite is selected from the group consisting of ZSM-5, ZSM-11, ZSM-12, ZSM-23, ZSM-35, ZSM-38, ZSM-48, ZSM-57, Zeolite beta, mordenite and preferably ZSM-5.

24. A process according to claim 20 wherein the stabilized high silica zeolite contains optionally clay selected from the group consisting of kaolin and halloysite.

25. A process according to claim 20 wherein the phosphate source is selected from the group consisting of phosphoric acid, ammonium di hydrogen phosphate, ammonium mono hydrogen phosphate, tri-ammonium phosphate, ammonium hypophosphate, ammonium ortho phosphate, ammonium di hydrogen ortho-phosphate, ammonium mono hydrogen ortho-phosphate, ammonium hypo phosphite, ammonium di hydrogen ortho-phosphite or a mixture thereof.

26. A process according to claim 20 wherein the colloidal silica sol has a pH between 7.0 and 11.5.

27. A process according to claim 20 wherein the colloidal silica consists of silica particles having a mean diameter ranging from about 4 nm to 30 nm.

28. A process according to claim 20 wherein the colloidal silica contains soda in the range of from 0.01 to 0.20 wt%.

1 29. A process according to claim 20 wherein said silica sol is acidified to a pH
2 between 0.5 and 3.5 before use.

1 30. A process according to claim 20 wherein said silica sol is acidified using a acid
2 selected from group consisting of nitric acid, hydrochloric acid, formic acid and acetic acid.

1 31. A process according to claim 20 wherein said alumina is a pseudoboehmite.

1 32. A process according to claim 20 wherein said alumina has crystallite size ranging
2 from about 3 nm to about 30 nm.

1 33. A process according to claim 20 wherein said alumina has soda content ranging
2 between 0.001 and 0.1 wt%.

1 34. A process according to claim 20 wherein the alumina used is acidified using acids
2 selected from the group consisting of acetic acid, formic acid, nitric acid and hydrochloric acid
3 or a mixture thereof.

1 35. A process according to claim 20 wherein ratio of high silica zeolite to low silica
2 molecular sieve is in the range of 1-50:1-40.